The JPL Field Emission Spectrometer

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The Jet Propulsion Laboratory (JPL) Field Emission Spectrometer (FES) was built by Designs and Prototypes based on a set of functional requirements supplied by JPL. The instrument has a spectral resolution of 6 wavenumbers (wn) and can acquire spectra from either the Mid infrared (3-5 μm) or the Thermal Infrared (8-12 μm) depending on whether the InSb or HgCdTe detector is installed respectively. The instrument consists of an optical head, system unit and battery. 'The optical head, which is tripod mounted, includes the interferometer and detector dewar assembl y. Wavelength calibration of the interferometer is achieved using a Hcliun~-Neon laser diode. The dewar needs replenishing with liqued Nitrogen approximately every four hours. The system unit includes the controls for operation and the computer used for acquiring, viewing and processing spectra. Radiometric calibration is achieved with an external temperature-controlled blackbody that mounts on the fore-optics of the instrument. The blackbody can be set at 5 °C increments between 10 and 55 "C. The instrument is compact and weighs about 25lbs. Both the wavelength calibration and radiometric calibration of the instrument have been evaluated. The wavelength calibration was checked by comparison of the position of water features in a spectrum of the sky with their position in the output from a high resolution atmospheric model, The results indicate that the features in the sky spectrum are within 6-8 wn of their position in the model spectrum. The radiometric calibration was checked by first calibrating the instrument using the external blackbody supplied with the instrument and then measuring the radiance from another external blackbody at a series of temperatures. The temperature of these radiance spectra were then recovered by inverting Planck's law and the recovered temperatures compared to the measured blackbod y temperature. These results indicate that radiometric calibration is good to 0.5 °C over the range of temperatures 10 to 55 °C. The results also indicated that the instrument drifts slowly over time and should be recalibrated every 20 to 30 minutes in the field to ensure good radiometric fidelity.

The instrument has now been extensively tested in the field in the United States and Australia. These in situ field measurements are being used to validate emissivity spectra recovered from the Thermal Infrared Multi spectral Scanner (TI MS) and also the Australian CO_2 Laser. The availability of in situ measurements is proving crucial to validation of the spectra derived from the airborne instruments since many natural surfaces cannot be easil y transported back to the laboratory.